


ORIGINAL RESEARCH ARTICLE

Fecal incontinence and associated pelvic floor dysfunction during and one year after the first pregnancy

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Abstract

Introduction: Obstetric anal sphincter injury is an important risk factor for postpartum fecal incontinence but few studies have reported fecal incontinence occurring, even during pregnancy. The first objective of this study was to examine the prevalence of fecal incontinence, obstructed defecation and vaginal bulging early and late in pregnancy and postpartum. The second objective was to assess the association between symptoms in pregnancy, delivery characteristics, and bowel and vaginal bulging symptoms at 1 year postpartum.

Material and methods: This prospective cohort study was conducted between October 2014 and October 2017, including 898 nulliparous women enrolled with the maternity healthcare service in Örebro County, Sweden. The women responded to questionnaires regarding pelvic floor dysfunction in early and late pregnancy and at 8 weeks and 1 year postpartum. The data were analyzed using random effect logistic models estimating odds ratios (ORs) and generalized linear models estimating relative risks, with 95% confidence intervals (CIs).

Results: At 1 year postpartum, the prevalence of fecal incontinence, obstructed defecation and vaginal bulging was 6% (40/694), 28% (197/699) and 8% (56/695), respectively. Among women with vaginal delivery, the risk of fecal incontinence and vaginal bulging increased significantly both in late pregnancy, with ORs of 3.4 (95% CI 1.5–7.7) and 3.6 (95% CI 1.6–8.1), respectively, and at 1 year postpartum, with ORs of 5.0 (95% CI 2.1–11.5) and 8.3 (95% CI 3.8–18.1), respectively, compared with early pregnancy. Among all women, factors associated with increased prevalence of fecal incontinence 1 year postpartum were fecal incontinence during pregnancy (adjusted relative risk [aRR] 7.4; 95% CI 4.1–13.3), obstructed defecation during pregnancy (aRR 2.0; 95% CI 1.1–3.9) and concurrent obstructed defecation (aRR 2.4; 95% CI 1.3–4.5).

Conclusions: This prospective study shows an increased risk of fecal incontinence by late pregnancy, suggesting that the pregnancy itself may be involved in the

Abbreviations: aRR, adjusted relative risk; BMI, body mass index; CI, confidence interval; OASI, obstetric anal sphincter injury; OR, odds ratio; POPRACT study, Pelvic Floor in Pregnancy and Childbirth study; RR, risk ratio.

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development of postpartum fecal incontinence. Obstructed defecation during pregnancy and postpartum was found to be associated with increased risk of fecal incontinence postpartum, indicating that postpartum fecal incontinence may be a result of incomplete bowel emptying.

KEYWORDS

anal incontinence, fecal incontinence, incomplete bowel evacuation, obstructed defecation, pelvic organ prolapse, prospective cohort study, vaginal bulging

1 | INTRODUCTION

Pregnancy and childbirth are associated with various pelvic floor disorders.¹ Fecal incontinence is one of the most serious pelvic floor disorders that can develop postpartum, having a significant negative impact on the quality of life of those affected.² Investigating the underlying mechanisms of this condition is a prerequisite for taking preventive actions. Several studies have reported an association between obstetric anal sphincter injury (OASI) and postpartum fecal incontinence.³ Pelvic organ prolapse, including rectocele and symptoms of vaginal bulging, is more common in women with a history of previous vaginal delivery.^{4,5} Rectocele is associated with obstructed defecation,⁶ and a similar association has been hypothesized between obstetric perineal tears and obstructed defecation.⁷ However, attempts to demonstrate this latter association have failed.⁷

The reported association between vaginal delivery and pelvic floor disorders is mainly based on studies using retrospective data collection.¹ The few prospective studies that enrolled women during pregnancy found that symptoms of fecal incontinence,⁸⁻¹⁰ incomplete bowel evacuation⁸ and vaginal bulging¹¹ occurred even during pregnancy, and that these symptoms persisted postpartum. Some studies have reported an association between bowel evacuation problems and anal incontinence during pregnancy and postpartum.^{12,13}

The findings indicate that fecal incontinence and impaired defecatory functioning during pregnancy may contribute to postpartum bowel incontinence. The few studies examining changes in fecal incontinence during pregnancy are at odds.^{8,10,14} To explore further the role of pregnancy and vaginal delivery and their respective contribution to the development of fecal incontinence and related disorders, we utilized data from a large prospective cohort study following women from early pregnancy to 1 year postpartum. The objective of the present study was twofold: first, to examine the prevalence of fecal incontinence, obstructed defecation and vaginal bulging early and late in pregnancy and postpartum; and secondly, to assess the association between symptoms in pregnancy, delivery characteristics, and bowel and vaginal bulging symptoms 1 year postpartum.

Key message

This prospective cohort study shows that, in the study cohort, the risk of fecal incontinence increased by late pregnancy and persisted postpartum, suggesting an independent impact of pregnancy.

2 | MATERIAL AND METHODS

The Pelvic Floor in Pregnancy and Childbirth (POPRACT) study is a prospective cohort study conducted in Region Örebro County, Sweden.¹⁵⁻¹⁷ Nulliparous women registering for maternity health care at primary care centers in early pregnancy between October 1, 2014 and October 1, 2017 were invited to participate by the midwife in charge. Participants were invited to complete web-based questionnaires on four occasions: at study entry; at 36 weeks' gestation; at 8 weeks postpartum; and at 1 year postpartum. Questionnaires included items derived from validated instruments on pelvic floor dysfunction^{18,19} (Appendix S1). This article focuses on the women who provided relevant information on at least one of the following occasions: in early pregnancy, in late pregnancy and at 1 year postpartum. Symptoms at 8 weeks postpartum are often transient and were therefore not included.

2.1 | Outcomes

Fecal incontinence, the primary outcome, was considered to be present if participants replied in the affirmative to the two relevant questions (leakage of liquid or solid stool). The terminology used for pelvic floor dysfunction was in accordance with the joint reports from the International Urogynecological Association and the International Continence Society.^{20,21} Data on fecal incontinence measured at three time points (early pregnancy, late pregnancy and 1 year postpartum) were used to assess the effect of progression of pregnancy and delivery on changes in the risk of this outcome. Fecal incontinence reported at 1 year postpartum was used as the outcome to evaluate the impact of

pregnancy characteristics, vaginal delivery and vaginal delivery characteristics on fecal incontinence, as well as to evaluate the association between fecal incontinence and other other pelvic floor symptoms.

Secondary outcomes were obstructed defecation and vaginal bulging. Obstructed defecation was defined as reporting the sensation of incomplete bowel evacuation and/or need for vaginal digitation or splinting to complete bowel evacuation. Vaginal bulging was defined as reporting this symptom "often" or "sometimes", and was compared with the group reporting this symptom "infrequently" or "never." Obstructed defecation and vaginal bulging, measured at the three time points, were used to assess the effect of progression of pregnancy and delivery on changes in the prevalence of these outcomes. The impact of pregnancy characteristics, vaginal delivery and vaginal delivery characteristics on obstructed defecation and vaginal bulging at 1 year postpartum was evaluated, as were any relationships with other pelvic floor symptoms.

2.2 | Exposures

The present study focused on risk factors for pelvic floor dysfunction. Data on delivery mode were extracted from the obstetric record system and used in pursuing both objectives of the study. Delivery was classified into vaginal delivery, including both spontaneous and instrumental deliveries, and cesarean section, including both acute and elective cesarean sections. In addition to delivery

mode, the following exposures were included in the analysis of association with the outcome at 1 year postpartum:

Degree of perineal tear was classified into (a) no tear or first-degree tear; (b) second-degree tear; (c) OASI. Vaginal tear was classified into (a) no or low vaginal tear; (b) high vaginal tear. The collection of data on delivery characteristics is described in a previous publication on this study cohort.¹⁵

Fecal incontinence, obstructed defecation, and vaginal bulging during pregnancy were also included in the analysis to see whether they were associated with the risk of the same symptoms at 1 year postpartum. Symptoms of slow bowel transit during pregnancy were examined to investigate whether they were associated with the outcome measures at 1 year postpartum. Slow bowel transit symptoms were defined as reporting fewer than three bowel movements per week and/or experiencing hard stools "sometimes" or "often".

2.3 | Delineation of basic characteristics

Data on education level was extracted from the questionnaire completed in early pregnancy. Body mass index (BMI) was calculated based on data registered with maternity healthcare. BMI at 1 year postpartum was calculated based on self-reported data from the questionnaire. In this study, BMI was grouped into three categories: $\leq 25 \text{ kg/m}^2$, $25.1\text{--}30 \text{ kg/m}^2$ and $>30 \text{ kg/m}^2$. Maternal age at delivery was categorized into ≤ 35 and >35 years.

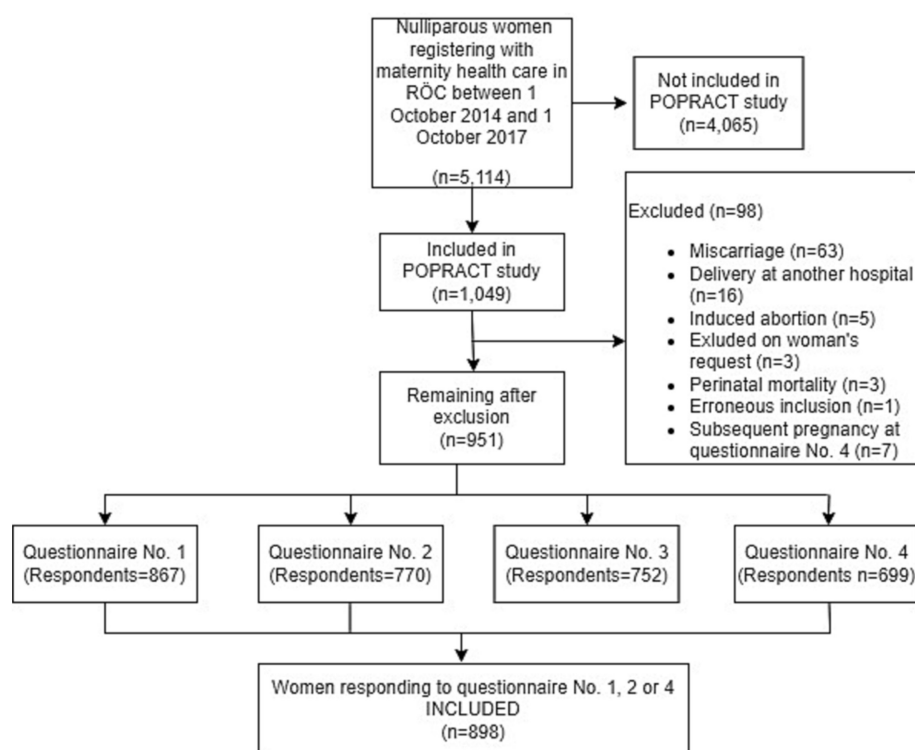


FIGURE 1 Flowchart illustrating the sample process. A total of 898 women provided information on at least one of the three measurement occasions. Of these, 98 women only answered once. POPRACT study, Pelvic Floor in Pregnancy and Childbirth study; RÖC, Region Örebro County.

TABLE 1 Women with fecal incontinence, obstructed defecation and vaginal bulging at follow-up at 1 year postpartum, by maternal and obstetric characteristics and conditions during pregnancy and postpartum. Number with symptom/total number responses to actual question (percentage). The characteristics of the total sample are displayed as number/total number with the available data (percentage). Total sample $n=898$.

	Total sample n (%) ($n=898$)	Fecal incontinence, 1 year postpartum ^a ($n=694$)	Obstructed defecation, 1 year postpartum ^b ($n=699$)	Vaginal bulging, 1 year postpartum ^c ($n=695$)
Age at delivery				
≤25 years	155/842 (18)	4/123 (3)	41/125 (33)	11/124 (9)
26–30 years	431/842 (51)	17/354 (5)	89/355 (25)	30/354 (8)
31–35 years	200/842 (23)	14/172 (8)	52/174 (30)	13/172 (8)
>35 years	56/842 (7)	5/45 (11)	15/45 (33)	2/45 (4)
BMI in early pregnancy				
≤25 kg/m ²	532/861 (62)	22/405 (5)	117/408 (29)	29/407 (7)
25.1–30 kg/m ²	229/861 (27)	11/179 (6)	43/179 (24)	17/176 (10)
>30 kg/m ²	100/861 (12)	5/82 (6)	29/84 (35)	3/84 (4)
BMI at 1 year postpartum				
≤25 kg/m ²	408/688 (59)	25/405 (6)	118/408 (29)	30/407 (7)
25.1–30 kg/m ²	180/688 (26)	7/179 (4)	42/180 (23)	20/179 (11)
>30 kg/m ²	100/688 (15)	8/99 (8)	34/100 (34)	6/98 (6)
Education				
9–<12 years	14/864 (2)	0/100 (0)	2/9 (22)	0/9 (0)
12 years	296/864 (34)	18/220 (8)	64/222 (29)	16/221 (7)
University	554/864 (64)	20/438 (5)	123/441 (28)	33/438 (8)
Smoking				
Yes	21/862 (2)	3/14 (21)	3/14 (21)	1/12 (8)
No	841/862 (98)	35/654 (5)	186/659 (28)	49/656 (7)
Obstetric characteristics				
Delivery mode				
Spontaneous vaginal delivery	574/838 (68)	28/479 (6)	136/482 (28)	44/478 (9)
Vacuum extraction	135/838 (16)	7/113 (6)	37/114 (32)	8/114 (7)
Elective cesarean section	79/838 (9)	4/64 (6)	13/64 (20)	3/64 (5)
Acute cesarean section	50/838 (6)	1/36 (3)	10/37 (27)	1/37 (3)
Degree of perineal tear				
None or first-degree	259/554 (47)	13/217 (6)	58/218 (27)	21/217 (10)
Second-degree	255/554 (46)	12/223 (5)	63/223 (28)	19/222 (9)
Obstetric anal sphincter injury	40/554 (7)	4/32 (13)	13/33 (40)	4/33 (12)
Vaginal tear				
None or low vaginal tear	463/541 (86)	23/395 (6)	108/397 (27)	40/395 (10)
High vaginal tear	78/541 (14)	5/68 (7)	22/69 (32)	5/69 (7)
Conditions during pregnancy and postpartum				
Fecal incontinence^a during pregnancy				
Yes	38/732 (5)	12/35 (34)	10/35 (29)	3/35 (9)
No	694/732 (95)	26/581 (4)	166/585 (28)	45/581 (8)
Obstructed defecation during pregnancy				
Yes	353/788 (45)	24/289 (8)	129/290 (44)	25/288 (9)
No	534/788 (55)	15/394 (4)	65/398 (16)	28/396 (7)
Vaginal bulging^c during pregnancy				
Yes ("often" or "sometimes")	40/713 (6)	2/32 (6)	14/32 (44)	8/32 (25)
No ("never" or "infrequently")	673/713 (94)	37/651 (6)	180/656 (27)	45/652 (7)

TABLE 1 (Continued)

	Total sample <i>n</i> (%) (<i>n</i> = 898)	Fecal incontinence, 1 year postpartum ^a (<i>n</i> = 694)	Obstructed defecation, 1 year postpartum ^b (<i>n</i> = 699)	Vaginal bulging, 1 year postpartum ^c (<i>n</i> = 695)
Slow bowel transit symptoms ^d during pregnancy				
Yes	575/887 (65)	24/449 (5)	141/451 (31)	36/449 (8)
No	312/887 (35)	15/234 (6)	53/237 (22)	17/235 (7)
Slow bowel transit symptoms at 1 year postpartum				
Yes	258/698 (37)	17/256 (7)	106/258 (41)	23/255 (9)
No	440/698 (63)	23/437 (5)	91/440 (21)	33/439 (8)

Abbreviations: BMI, body mass index; FI, fecal incontinence; OD, obstructed defecation; VB, vaginal bulging.

^a"Fecal incontinence" refers to leakage of either liquid or solid feces.

^b"Obstructed defecation" refers to the sensation of incomplete bowel evacuation and/or the need to digitate to complete bowel evacuation.

^c"Vaginal bulging" was defined as reporting a sensation of tissue protrusion from the vagina "often" or "sometimes".

^d"Slow bowel transit symptoms" were defined as reporting fewer than three bowel movements per week and/or experiencing hard stools "often" or "sometimes".

TABLE 2 Fecal incontinence, obstructed defecation and vaginal bulging in early and late pregnancy and at 1 year postpartum. Number with symptom/total number responses to actual question (percentage). Total sample *n* = 898.

	Early pregnancy <i>n</i> (%)	Late pregnancy <i>n</i> (%)	1 year postpartum <i>n</i> (%)
Fecal incontinence ^a			
Yes	15/856 (2)	32/755 (4)	40/694 (6)
Fecal incontinence, liquid			
Yes	13/859 (2)	30/758 (4)	35/694 (5)
Fecal incontinence, solid			
Yes	4/865 (<1)	6/767 (1)	11/699 (2)
Obstructed defecation ^b			
Yes	240/867 (28)	232/770 (30)	197/699 (28)
Vaginal digitation and/or splinting			
Yes	62/866 (7)	65/769 (8)	55/696 (8)
Incomplete bowel evacuation			
Yes	209/864 (24)	204/768 (27)	182/697 (26)
Vaginal bulging			
Yes ("often" or "sometimes")	13/867 (2)	30/770 (4)	56/695 (8)

^a"Fecal incontinence" refers to leakage of either liquid or solid feces.

^b"Obstructed defecation" refers to the sensation of incomplete bowel evacuation and/or the need to digitate to complete bowel evacuation.

2.4 | Study size

Given the multiple outcomes with unknown incidence, the required sample size for the whole POPRACT study was difficult to estimate precisely. Inclusion was terminated after 3 years when slightly more than 1000 women had been included, which was judged to

be sufficient for detecting risk factors for most outcomes, although perhaps not for rare risk factors.

2.5 | Statistical analyses

Descriptive data are presented as frequencies, proportions and means with standard deviations (SDs). In the analysis examining the change in the risk of fecal incontinence, obstructed defecation and vaginal bulging over time, we used random effect logistic models to estimate odds ratios (ORs) with 95% confidence intervals (CIs). The strength of the model is the ability to include also women who did not participate at all three of the estimation time points.²² Early pregnancy was used as the reference, and the subsequent two time points (late pregnancy and 1 year postpartum) were compared with this. Additionally, ORs between late pregnancy and 1 year postpartum were tested to assess whether the risk changed between these two time points. The model was adjusted for age, BMI in early pregnancy and educational level.

Subsequently, using the adjusted model, estimated probabilities with 95% CIs were calculated for each time point. The analyses were conducted separately on women who underwent vaginal delivery and on women with cesarean section. For assessing the impact of pregnancy and delivery characteristics on the outcome measures at 1 year postpartum, we used generalized linear models with binomial distribution and log link function to estimate risk ratios (RRs) with 95% CIs. First, we obtained unadjusted associations of delivery and postpartum characteristics with the outcome measures at 1 year postpartum. Next, we fitted a model separately for each of the delivery and postpartum factors, adjusting for the potential confounders age, BMI at 1 year postpartum and educational level. Each condition was analyzed independently to avoid the effect of a condition being adjusted away by including other conditions in the model simultaneously. Data were analyzed using version 16 of STATA/SE (StataCorp LP).

TABLE 3 Odds ratios and estimated probability of fecal incontinence, obstructed defecation and vaginal bulging over time among women with vaginal delivery and among women with cesarean section. Estimates are adjusted for age, body mass index in early pregnancy and educational level.

	Early pregnancy		Late pregnancy		1 year postpartum	
	Women with vaginal delivery	Women with cesarean section	Women with vaginal delivery	Women with cesarean section	Women with vaginal delivery	Women with cesarean section
Fecal incontinence	n=669	n=122	n=612	n=103	n=567	n=95
Adjusted OR (95% CI)	1.00	1.00	3.4 (1.5–7.7) $P=0.004^*$	3.4 (0.49–24.1) $P=0.21$	5.0 (2.1–11.5) $P<0.001^*$	3.27 (0.51–21.1) $P=0.21$
Estimated probability (95% CI)	2% (1%–3%)	2% (–1% to 4%)	5% (3%–6%)	4% (0%–7%)	6% (4%–8%)	5% (1%–9%)
Obstructed defecation	n=678	n=122	n=622	n=107	n=571	n=96
Adjusted OR (95% CI)	1.00	1.00	1.1 (0.83–1.5), $P=0.51$	1.5 (0.65–3.3), $P=0.36$	1.0 (0.76–1.4), $P=0.90$	1.0 (0.4–2.4), $P=1.0$
Estimated probability (95% CI)	28% (25%–31%)	25% (18%–32%)	29% (26%–33%)	28% (20%–36%)	28% (25%–32%)	24% (16%–32%)
Vaginal bulging	n=678	n=64	n=622	n=61	n=567	n=52
Adjusted OR (95% CI)	1.00	1.00	3.6 (1.6–8.1), $P=0.002^*$	1.6 (0.25–10.3), $P=0.62$	8.3 (3.8–18.1), $P<0.001^*$	1.3 (0.17–9.3), $P=0.81$
Estimated probability (95% CI)	1% (0%–2%)	5% (–1%–10%)	4% (3%–6%)	7% (0%–13%)	8% (6%–10%)	6% (–1% to 12%)

Abbreviations: CI, confidence interval; OR, odds ratio.

* $P < 0.05$.

2.6 | Ethics statement

Ethical approval was given by the Regional Ethical Review Board in Stockholm on February 21, 2014 (registration number: 2014/124–32). All participants provided written informed consent upon recruitment.

3 | RESULTS

Of the 1049 women included in the POPRACT study, 898 provided information on at least one of the three occasions (Figure 1 for inclusion of the study sample). Mean age at delivery (SD, range) was 28.9 (4.0, 19–41) years, mean BMI in early pregnancy was 24.7 (4.4, 16.6–45.4) kg/m² and mean BMI at 1 year postpartum was 25.0 (5.0, 16.8–46.6) kg/m². Mean (SD) gestational age at completing questionnaires 1 and 2 was 11+6 weeks (2+4 weeks) and 31 weeks (3+4 weeks), respectively. Mean (SD) time postpartum of completing the last questionnaires was 1 year+2 weeks+5 days (3 weeks), respectively. Maternal and obstetric characteristics, by fecal incontinence, obstructed defecation and vaginal bulging at 1 year postpartum, are presented in Table 1.

3.1 | Risk of fecal incontinence, obstructed defecation and vaginal bulging over time

At 1 year postpartum, the prevalence of fecal incontinence, obstructed defecation and vaginal bulging was 6%, 28% and 8%, respectively (Table 2). Prevalences of miscellaneous bowel and vaginal symptoms not included in the analysis are presented in Table S1.

Among women with vaginal delivery, the ORs for fecal incontinence and vaginal bulging were significantly increased in late pregnancy and at 1 year postpartum compared with early pregnancy (Table 3, Figure 2). When we compared late pregnancy with 1 year postpartum, the OR for vaginal bulging was 2.3 (95% CI 1.3–3.9, $P=0.003$), indicating that the risk further increased from late pregnancy to 1 year postpartum. However, no such increment from late pregnancy to 1 year postpartum was seen for fecal incontinence (OR 1.3; 95% CI 0.77–2.2; $P=0.335$). The likelihood of obstructed defecation did not change significantly from early pregnancy to 1 year postpartum. The ORs for each pelvic floor dysfunction among women with cesarean section are presented for comparison.

3.2 | Factors associated with fecal incontinence at 1 year postpartum

Among all women, the following factors were statistically significantly associated with higher risk of fecal incontinence at 1 year postpartum: namely, reporting fecal incontinence during pregnancy; reporting obstructed defecation during pregnancy; and reporting obstructed defecation at 1 year postpartum (Table 4). These

associations remained after adjustment for age, BMI at 1 year postpartum and education level. Neither delivery mode nor degree of perineal tear was associated with higher risk of fecal incontinence.

3.3 | Factors associated with obstructed defecation and vaginal bulging at 1 year postpartum

Obstructed defecation during pregnancy, vaginal bulging during pregnancy, vaginal bulging at 1 year postpartum, slow transit symptoms during pregnancy and slow transit symptoms at 1 year postpartum were associated with higher risk of obstructed defecation at 1 year postpartum, and these associations remained after adjustment (Table 4). Vaginal bulging during pregnancy was associated with vaginal bulging at 1 year postpartum, and this remained the case after adjustment. No association was found between delivery mode or degree of perineal tear, and obstructed defecation or vaginal bulging.

4 | DISCUSSION

Among the studied women with vaginal delivery, the risk of fecal incontinence and vaginal bulging increased significantly in late pregnancy. The risk of fecal incontinence remained at a similar level, whereas the risk of vaginal bulging had further increased by 1 year postpartum. For women with cesarean section, there was a similar increase in the risk of these symptoms in pregnancy, also persisting postpartum; however, the samples were smaller and the changes were not statistically significant. Fecal incontinence during pregnancy, obstructed defecation during pregnancy and obstructed defecation at 1 year postpartum were all associated with higher risk of fecal incontinence 1 year postpartum.

The prospective design using both data collected from early pregnancy to postpartum and a large study sample enabled us to show that risk of fecal incontinence had increased by late pregnancy and remained at a similar level 1 year postpartum, which to our knowledge has not been documented previously. One

previous study has shown an increase in fecal incontinence during pregnancy,¹⁴ but only a small fraction of the study population was followed from early to late pregnancy and no data on postpartum fecal incontinence were reported. By contrast, two other similar studies showed no increase either during pregnancy or at 1 year postpartum.^{8,10} Our sample size was about twice as large as that of the two latter studies,^{8,10} which is important, as the probability of detecting changes in fecal incontinence increases with increased sample size. Bowel evacuation problems during pregnancy and postpartum have elsewhere been associated with anal incontinence postpartum,^{12,13} but to our knowledge no previous study has shown the association between obstructed defecation and postpartum fecal incontinence.

Most studies of postpartum fecal incontinence focus on the mechanical injuries caused by vaginal delivery, including OASI. Our findings, however, support the hypothesis that the pregnancy itself is involved in the development of such incontinence. Obstructed defecation both during pregnancy and postpartum was associated with increased prevalence of fecal incontinence postpartum, and this could be explained by residual feces in the ampulla recti after defecation, resulting in post-defecatory fecal loss. This pathophysiological mechanism is similar to that described in fecal soiling.²³ However, we could not examine whether the women had experienced fecal soiling, as our study questionnaire did not include any questions specifically covering fecal soiling.

In the present study, there was no association between severity of perineal tear and fecal incontinence, whereas several previous studies have demonstrated increased risk of fecal incontinence due to OASI.³ An insufficient sample size for this rare outcome might explain why the association did not reach significance in our study. The lack of association between obstructed defecation and severity of perineal or vaginal tear is in line with a previous study by Rotstein et al.⁷

An increased risk of vaginal bulging during pregnancy and at 1 year postpartum, compared with early pregnancy, has not been demonstrated previously. Reimers et al. reported a generally higher prevalence of vaginal bulging compared with the present study, but found no change in prevalence during pregnancy and postpartum.²⁴ We used a more restrictive cutoff for vaginal bulging, based

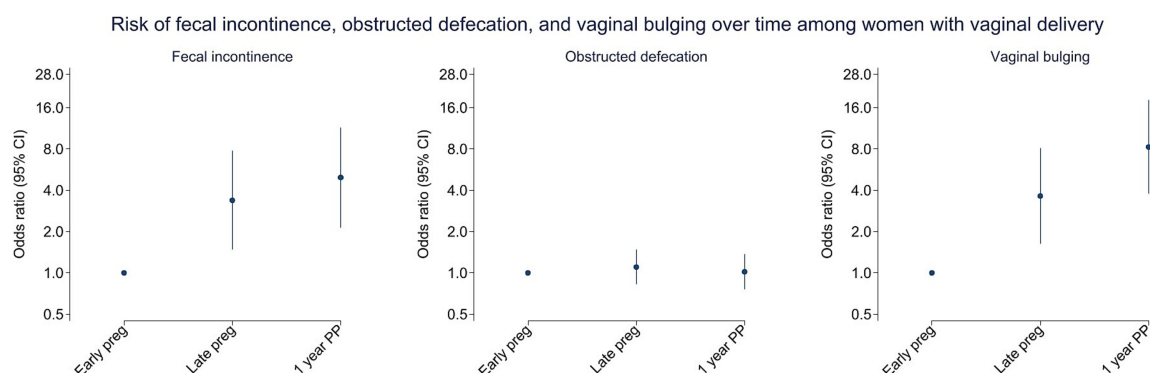


FIGURE 2 Odds ratios for fecal incontinence, obstructed defecation and vaginal bulging in late pregnancy and at 1 year postpartum compared with early pregnancy in women with vaginal delivery. CI, confidence interval; PP, postpartum; preg, pregnancy.

TABLE 4 Unadjusted and adjusted risk ratios for the association between potential risk factors and fecal incontinence, obstructed defecation and vaginal bulging at 1 year postpartum. Each obstetrics characteristic and condition during pregnancy and postpartum was analyzed separately. Age, BMI at 1 year postpartum and education were included as potential confounders and were mutually accounted for.

	Fecal incontinence		Obstructed defecation		Vaginal bulging	
	Unadjusted RR (95% CI)	Adjusted RR (95% CI)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Obstetric characteristics						
Delivery mode	<i>n</i> = 692	<i>n</i> = 654	<i>n</i> = 697	<i>n</i> = 659	<i>n</i> = 693	<i>n</i> = 655
Cesarean section	1.00	1.00	1.00	1.00	1.00	1.00
Vaginal	1.2 (0.47–3.0) <i>P</i> = 0.72	1.2 (0.46–2.9) <i>P</i> = 0.77	1.3 (0.87–1.9) <i>P</i> = 0.21	1.3 (0.9–1.9) <i>P</i> = 0.19	2.2 (0.8–6.0) <i>P</i> = 0.11	2.5 (0.8–7.8) <i>P</i> = 0.12
Degree of perineal tear	<i>n</i> = 472	<i>n</i> = 443	<i>n</i> = 474	<i>n</i> = 445	<i>n</i> = 472	<i>n</i> = 426
None or first-degree	1.00	1.00	1.00	1.00	1.00	1.00
Second-degree	0.9 (0.42–1.9) <i>P</i> = 0.78	0.8 (0.38–1.8) <i>P</i> = 0.64	1.1 (0.8–1.4) <i>P</i> = 0.70	0.95 (0.69–1.3) <i>P</i> = 0.74	0.88 (0.49–1.6) <i>P</i> = 0.68	0.7 (0.37–1.3) <i>P</i> = 0.28
Obstetric anal sphincter injury	2.1 (0.72–6.0) <i>P</i> = 0.17	1.2 (0.29–5.1) <i>P</i> = 0.79	1.5 (0.92–2.4) <i>P</i> = 0.11	1.5 (0.88–2.4) <i>P</i> = 0.14	1.3 (0.46–3.4) <i>P</i> = 0.66	1.1 (0.3–3.4) <i>P</i> = 0.91
Vaginal tear	<i>n</i> = 463	<i>n</i> = 434	<i>n</i> = 466	<i>n</i> = 437	<i>n</i> = 464	<i>n</i> = 418
None or low vaginal tear	1.00	1.00	1.00	1.00	1.00	1.00
High vaginal tear	1.3 (0.5–3.2) <i>P</i> = 0.62	1.2 (0.4–3.2) <i>P</i> = 0.79	1.2 (0.8–1.7) <i>P</i> = 0.41	1.3 (0.86–1.9) <i>P</i> = 0.22	0.72 (0.29–1.8) <i>P</i> = 0.46	0.66 (0.24–1.8) <i>P</i> = 0.42
Conditions during pregnancy and postpartum						
Fecal incontinence during pregnancy	<i>n</i> = 616	<i>n</i> = 603				
No	1.00	1.00	NE	NE	NE	NE
Yes	7.7 (4.2–13.9) <i>P</i> < 0.01*	7.4 (4.1–13.3) ^a <i>P</i> < 0.01*	NE	NE	NE	NE
Obstructed defecation during pregnancy	<i>n</i> = 647	<i>n</i> = 627	<i>n</i> = 652	<i>n</i> = 632	<i>n</i> = 648	<i>n</i> = 628
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	2.1 (1.1–4.0) <i>P</i> = 0.02*	2.0 (1.1–3.9) <i>P</i> = 0.03*	2.6 (2.0–3.4) <i>P</i> < 0.01*	2.7 (2.0–3.5) <i>P</i> < 0.01*	1.2 (0.69–1.9) <i>P</i> = 0.58	1.1 (0.62–1.9) <i>P</i> = 0.80
Obstructed defecation at 1 year postpartum	<i>n</i> = 694	<i>n</i> = 656				
No	1.00	1.00	NE	NE	NE	NE
Yes	2.6 (1.4–4.7) <i>P</i> < 0.01*	2.4 (1.3–4.5)* <i>P</i> < 0.01*	NE	NE	NE	NE
Slow bowel transit symptoms during pregnancy	<i>n</i> = 683	<i>n</i> = 656			<i>n</i> = 684	<i>n</i> = 657
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.83 (0.45–1.6) <i>P</i> = 0.57	0.80 (0.43–1.5) <i>P</i> = 0.53	1.4 (1.06–1.84) <i>P</i> = 0.02*	1.5 (1.1–2.0) <i>P</i> < 0.01*	1.1 (0.64–1.9) <i>P</i> = 0.72	1.3 (0.70–2.3) <i>P</i> = 0.42
Slow bowel transit symptoms at 1 year postpartum	<i>n</i> = 693	<i>n</i> = 655			<i>n</i> = 694	<i>n</i> = 656
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	1.3 (0.69–2.3) <i>P</i> = 0.45	1.4 (0.75–2.6) <i>P</i> = 0.30	2.0 (1.6–2.5) <i>P</i> < 0.01*	2.0 (1.6–2.5) ^b <i>P</i> < 0.01*	1.2 (0.72–2.0) <i>P</i> = 0.48	1.3 (0.76–2.3) <i>P</i> = 0.33
Vaginal bulging during pregnancy	<i>n</i> = 683	<i>n</i> = 656	<i>n</i> = 688	<i>n</i> = 661	<i>n</i> = 633	<i>n</i> = 586
No	1.00	1.00	1.00	1.00	1.00	1.00

(Continues)

TABLE 4 (Continued)

	Fecal incontinence		Obstructed defecation		Vaginal bulging	
	Unadjusted RR (95% CI)	Adjusted RR (95% CI)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)	Unadjusted RR (95% CI)	Adjusted RR (95% CI)
Yes	1.0 (0.3–4.1) <i>P</i> =0.95	1.1 (0.3–4.3) <i>P</i> =0.89	1.6 (1.0–2.4) <i>P</i> =0.03*	1.9 (1.2–2.8) <i>P</i> <0.01*	3.8 (1.9–7.3) <i>P</i> <0.01*	3.8 (1.9–7.4) <i>P</i> <0.01*
Vaginal bulging at 1 year postpartum	<i>n</i> =690	<i>n</i> =652	<i>n</i> =695	<i>n</i> =657		
No	1.00	1.00	1.00	1.00	NE	NE
Yes	1.7 (0.68–4.1) <i>P</i> =0.27	2.1 (0.84–5.1) <i>P</i> =0.11	1.6 (1.2–2.2)* <i>P</i> <0.01*	1.6 (1.1–2.2)* <i>P</i> =0.02*	NE	NE

Abbreviations: BMI, body mass index; CI, confidence interval; NE, not estimated; RR, risk ratio.

**P* < 0.05.

^aThe estimate was not adjusted for age because none of the women had the combination of reporting fecal incontinence during pregnancy, reporting no fecal incontinence at 1 year postpartum and being older than 35 years.

^bThe estimate was not adjusted for BMI because none of the women had the combination of reporting obstructed defecation at 1 year postpartum, being older than 35 years, reporting no fecal incontinence at 1 year postpartum and having a BMI >25.

on frequency, whereas Reimers et al. used responding in the affirmative.²⁴ This may explain their higher overall prevalence, but does not reasonably explain the difference in change in vaginal bulging during pregnancy and postpartum. Increased risk of vaginal bulging symptoms postpartum compared with early pregnancy could be due to mechanical distention or injuries to the pelvic floor during vaginal delivery, including increased levator hiatus area or levator ani avulsion, which may lead to pelvic organ prolapse.²⁵

The increased risk of vaginal bulging symptoms during late pregnancy should be interpreted with caution. Reimers et al. showed a decrease in anatomical pelvic organ prolapse between the second and third trimester,²⁶ and found no correlation between the symptoms of vaginal bulging and anatomical pelvic organ prolapse during pregnancy.²⁴

The questions used in the present study were validated either in a general population¹⁸ or among women with pelvic floor disorders.¹⁹ There is a general lack of such validation in postpartum women; therefore, we cannot exclude the possibility of some degree of misclassification. Although we adhered to the current terminology for pelvic floor dysfunction,^{20,21} it is difficult to compare our results adequately with those of others because of a variety of outcome measures used across studies.

Separating women in the analysis based on the occurrence of pre-delivery pelvic floor symptoms could have enhanced our ability to detect delivery-related risk factors, but we were unable to do this because the sample size was insufficient to stratify women by symptoms during pregnancy. We did not ask retrospective questions on pre-pregnancy symptoms. Although use of retrospective questions can pose a risk of recall bias, such information could possibly have helped us to isolate the effect of pregnancy on the development of pelvic floor symptoms.

Given the recruitment process and the response rate, selection bias cannot be ruled out in this study. Indeed, we observed that our study population had a higher educational level and lower likelihood of smoking compared with the overall Swedish pregnant

population.²⁷ How this may have influenced the prevalence of fecal incontinence in our study and the association we examined is difficult to answer. Educational level is a marker of socioeconomic status, which is known to affect health in general; however, the few studies that have investigated the association between educational level and fecal or anal incontinence have had conflicting results.^{28,29}

There is still no formal core outcome set in this research field; developing such an outcome set would help to enhance comparability between studies. There is also a need for questionnaires on pelvic floor dysfunction to be validated in women, both during pregnancy and postpartum. Our results indicate that such questionnaires should include questions on fecal soiling. Further studies examining the association between pregnancy/delivery and pelvic floor symptoms should ideally include and correct for symptoms already present before pregnancy.

Postpartum fecal incontinence is used as a marker of quality both in general maternity care and in the specific care after OASI. Evaluating the quality of care based on the prevalence of postpartum fecal incontinence carries a risk of overestimating the complication rates if no data on pre-delivery fecal incontinence are provided. Pre-delivery fecal incontinence and other pelvic floor symptoms also problematize the idea of using cesarean section to prevent pelvic floor dysfunction. Fear of anal incontinence has been reported as a common reason among obstetricians to choose elective cesarean delivery,³⁰ but the present study does not support such a practice.

5 | CONCLUSION

This prospective study found that the risk of fecal incontinence had increased by late pregnancy, suggesting that the pregnancy itself is involved in the development of postpartum fecal incontinence. Obstructed defecation during pregnancy and postpartum was associated with increased risk of fecal incontinence postpartum,

indicating that postpartum fecal incontinence may be a result of incomplete bowel emptying. Our study does not support the use of elective cesarean section to prevent fecal incontinence.

AUTHOR CONTRIBUTIONS

MHJ: Project development, data collection, data analysis, article writing. KF: Project development, data analysis, article editing. GT: Data analysis, article editing. JB: Data analysis, article editing. AH: Support for data analysis, article editing. KN: Project development, data analysis, article editing.

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CONFLICT OF INTEREST STATEMENT

None declared.

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REFERENCES

- Abrams P, Cardozo L, Wagg A, Wein A. *Incontinence*. 6th ed. International Continence Society; 2017.
- Samarasekera DN, Bekhit MT, Wright Y, et al. Long-term anal continence and quality of life following postpartum anal sphincter injury. *Colorectal Dis*. 2008;10:793-799.
- LaCross A, Groff M, Saldone A. Obstetric anal sphincter injury and anal incontinence following vaginal birth: a systematic review and meta-analysis. *J Midwifery Womens Health*. 2015;60:37-47.
- Gyhaugen M, Bullarbo M, Nielsen TF, Milsom I. Prevalence and risk factors for pelvic organ prolapse 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery. *BJOG*. 2013;120:152-160.
- Dietz HP, Steensma AB. The role of childbirth in the aetiology of rectocele. *BJOG*. 2006;113:264-267.
- Karjalainen PK, Mattsson NK, Nieminen K, Tolppanen AM, Jalkanen JT. The relationship of defecation symptoms and posterior vaginal wall prolapse in women undergoing pelvic organ prolapse surgery. *Am J Obstet Gynecol*. 2019;221(480):e1-e10.
- Rotstein E, Ahlund S, Lindgren H, Linden Hirschberg A, Radestad I, Tegerstedt G. Posterior compartment symptoms in primiparous women 1 year after non-assisted vaginal deliveries: a Swedish cohort study. *Int Urogynecol J*. 2021;32:1825-1832.
- van Brummen HJ, Bruinse HW, van de Pol G, Heintz AP, van der Vaart CH. Defecatory symptoms during and after the first pregnancy: prevalences and associated factors. *Int Urogynecol J Pelvic Floor Dysfunct*. 2006;17:224-230.
- Brown SJ, Gartland D, Donath S, MacArthur C. Fecal incontinence during the first 12 months postpartum: complex causal pathways and implications for clinical practice. *Obstet Gynecol*. 2012;119:240-249.
- Chan SSC, Cheung RYK, Yiu KW, Lee LL, Chung TKH. Prevalence of urinary and fecal incontinence in Chinese women during and after their first pregnancy. *Int Urogynecol J*. 2013;24:1473-1479.
- Reimers C, Siafarikas F, Staer-Jensen J, Smastuen MC, Bø K, Ellstrom Engh M. Risk factors for anatomic pelvic organ prolapse at 6 weeks postpartum: a prospective observational study. *Int Urogynecol J*. 2019;30:477-482.
- Johannessen HH, Mørkved S, Stordahl A, Wibe A, Falk RS. Evolution and risk factors of anal incontinence during the first 6 years after first delivery: a prospective cohort study. *BJOG*. 2020;127:1499-1506.
- Johannessen HH, Stafne SN, Falk RS, Stordahl A, Wibe A, Mørkved S. Prevalence and predictors of anal incontinence 6 years after first delivery. *Neurourol Urodyn*. 2019;38:310-319.
- Rogers RG, Ninivaggio C, Gallagher K, Borders AN, Qualls C, Leeman LM. Pelvic floor symptoms and quality of life changes during first pregnancy: a prospective cohort study. *Int Urogynecol J*. 2017;28:1701-1707.
- Jansson MH, Franzén K, Hiyoshi A, Tegerstedt G, Dahlgren H, Nilsson K. Risk factors for perineal and vaginal tears in primiparous women—the prospective POPRACT-cohort study. *BMC Pregnancy Childbirth*. 2020;20:749.
- Jansson MH, Franzén K, Tegerstedt G, Hiyoshi A, Nilsson K. Stress and urgency urinary incontinence one year after a first birth—prevalence and risk factors. A prospective cohort study. *Acta Obstet Gynecol Scand*. 2021;100:2193-2201.
- Dahlgren H, Jansson MH, Franzén K, Hiyoshi A, Nilsson K. Sexual function in primiparous women: a prospective study. *Int Urogynecol J*. 2022;33:1567-1582.
- Tegerstedt G, Miedel A, Maehle-Schmidt M, Nyren O, Hammarstrom M. A short-form questionnaire identified genital organ prolapse. *J Clin Epidemiol*. 2005;58:41-46.
- Teleman P, Stenzelius K, Iorizzo L, Jakobsson U. Validation of the Swedish short forms of the pelvic floor impact questionnaire (PFIQ-7), pelvic floor distress inventory (PFDI-20) and pelvic organ prolapse/urinary incontinence sexual questionnaire (PISQ-12). *Acta Obstet Gynecol Scand*. 2011;90:483-487.
- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4-20.
- Sultan AH, Monga A, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female anorectal dysfunction. *Int Urogynecol J*. 2017;28:5-31.
- Gibbons RD, Hedeker D, DuToit S. Advances in analysis of longitudinal data. *Annu Rev Clin Psychol*. 2010;6:79-107.
- Rao SS, Ozturk R, Stessman M. Investigation of the pathophysiology of fecal seepage. *Am J Gastroenterol*. 2004;99:2204-2209.
- Reimers C, Staer-Jensen JE, Siafarikas F, Bø K, Engh ME. Association between vaginal bulge and anatomical pelvic organ prolapse during pregnancy and postpartum: an observational study. *Int Urogynecol J*. 2018;29:441-448.
- Handa VL, Roem J, Blomquist JL, Dietz HP, Munoz A. Pelvic organ prolapse as a function of levator ani avulsion, hiatus size, and strength. *Am J Obstet Gynecol*. 2019;221:41.e1-41.e7.
- Reimers C, Staer-Jensen J, Siafarikas F, Saltyte-Benth J, Bø K, Ellström Engh M. Change in pelvic organ support during pregnancy and the first year postpartum: a longitudinal study. *BJOG*. 2016;123:821-829.
- Stephansson O, Petersson K, Bjork C, Conner P, Wikstrom AK. The Swedish pregnancy register—for quality of care improvement and research. *Acta Obstet Gynecol Scand*. 2018;97:466-476.
- Schei B, Johannessen HH, Rydning A, Sultan A, Mørkved S. Anal incontinence after vaginal delivery or cesarean section. *Acta Obstet Gynecol Scand*. 2019;98:51-60.

29. Demir N, Yuruyen M, Atay K, et al. Prevalence of fecal incontinence and associated risk factors in elderly outpatients: a cross-sectional study. *Aging Clin Exp Res*. 2017;29:1165-1171.
30. Wax JR, Cartin A, Pinette MG, Blackstone J. Patient choice cesarean—the Maine experience. *Birth*. 2005;32:203-206.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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